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Reliability Analysis for the Static Inverter
Engineered Magnetics Model EMIR302
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REPORT NO. 2960
DATE: FEBRUARY 2, 1979
Contract No. DAAK70-77-C-0012

RELIABILITY ANALYSIS FOR THE STATIC INVERTER

ENGINEERED MAGNETICS MODEL EMIR302

PREPARED BY: Sharad Gandhi 2/2/79
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REVIEWED BY: J. Rance
J. Rance
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GULTON INDUSTRIES, INC.
ENGINEERED MAGNETICS DIVISION
13041 CERISE AVE., HAWTHORNE, CA. 90250

RELIABILITY ESTIMATE

1. The reliability prediction contained herein is prepared in conformance with the requirements of the reliability mathematical Model CDRL ITEM 006.
2. This reliability prediction is accomplished on the Static Inverter, Engineered Magnetics Model EMIR302, at the piece part level using the assumption as stated below.
   2.1 Failure rate is derived from the MIL-HDBK-217B for the "ground fixed" environment.
   2.2 Ambient temperature assumed is 50°C.
   2.3 Actual component stresses is used in the failure rate calculation.
3. The calculation for the failure rate is shown in the attached worksheet. The MTBF is calculated by summing the individual component part failure rate and then taking the reciprocal of this sum, i.e.,

$$MTBF = \frac{1}{\Sigma\lambda_i}$$

Where λ_i = individual component part failure rate.

4. The following is a tabulation for the individual assembly.

ASSEMBLY	λ FAILURE RATE (F/HR)
A1	33.274×10^{-6}
A2	33.274×10^{-6}
A3	33.274×10^{-6}
A4	6.33×10^{-6}
A5	8.407×10^{-6}
A6	$.1454 \times 10^{-6}$
Chassis	6.48×10^{-6}
Miscellaneous (Connection, PC Board, etc).	12.1×10^{-6}
	$\Sigma\lambda_i = 133.29 \times 10^{-6}$

Therefore MTBF = $\frac{1}{133.29 \times 10^{-6}}$

= 7502 hours.

5. The MTBF for the Static Inverter is 7502 hours which exceeds the requirement of 1200 hours per Army specification EED76022501, Paragraph 3.5.

APPENDIX

Equipment: EMIR 302 Assembly: CHASSIS "1" Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
BIODF (FAN) M1	0.001								3.0			0.131	0.131
			1.5			2.5						1	
MS16106-1 (S3)	0.407											0.407	0.407
			1.0		1.0				1.0			1	
MS 24524-23 (S2)	0.01											0.0175	0.0175
			1.0		1.75				1.0			1	
MS24525-21 (S1)	0.01											0.03	0.03
			1.0		3.0				1.0			1	
M83421/01-8324P (C1-3)	0.0019											0.00114	0.00456
M83421/01-9228P (C4) S≤80%	0.3		2.0									4	
JANIN577 (CR1) S≤0	0.0016				1.5	0.7						0.084	0.084
REVERSE POLARITY DIODE	5.0		5.0		2.0							1	
M55302/55-A40L (P1-4)	0.019	7.42										0.5639	2.255
			4.0									4	
M55302/60-A90X (J2)	0.019	21.19										1.61	1.61
			4.0									1	
M55302/58-A70X (J1)	0.019	14.6										1.109	1.109
			4.0									1	
225213-1 (LED) CR2-CR6												0.2	1.2
GE 327 OR DSI.												6	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

reparad by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 6.848 $\times 10^{-6}$ Failures/Hr

Equipment: EMIR 302 Assembly: A1 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_Q	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
171C150CC33 S<60% C1	.054											0.324	0.324
	3		2									1	
RH-25-.002Ω S≤12% R1	0.007						1.0					0.105	0.105
	5		3									1	
226069-1 S≤10% R2	0.0068											0.102	0.102
	5		3									1	
26014-1 (L1,L2) 90°C	0.0025								8.0			0.04	0.08
			2.0									2	
426018-1 (L3) 70°C	0.0022								8.0			0.0352	0.0352
			2.0									1	
426017-1 (T1) 70°C	0.0022								8.0			0.0352	0.0352
			2.0									1	
326004-1 (T2,T3) 70°C	0.0022								8.0			0.0352	0.0704
			2.0									2	
426016-1 (T4) 90°C	0.0025								8.0			0.040	0.04
			2.0									1	
426019-1 (T5) 70°C	0.0022								8.0			0.0352	0.0352
			2.0									1	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 0.827 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A1 Board/Ckt: _____

Ambient Temperature = 50°C. Environment: GROUND FIXED

PART IDENTIFICATION / COMPONENT / REMARKS	COMPUTATION FACTORS											PREDICTIONS	
	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
JANIN3910 (CR1, CR2)	0.0021				1.5	0.7	10.0					1.1025	8.82
JANIN1186 (CR7-CR10)	5.0		5.0		2.0							8	
JANIN1184 (CR11, CR12) S≤20%													
JANIN1202A (CR13, CR14)	0.0016				1.5	0.7	4.0					0.336	0.672
S≤10%	5.0		5.0		2.0							2	
JANIN5615 (CR3, CR4)	0.0047				1.5	0.7	1.0					0.123	0.246
S≤50%	5.0		5.0		1.0							2	
JANIN4938 (CR5, CR6)	0.0016				0.6	0.7	1.0					0.0168	0.0336
S≤10%	5.0		5.0		1.0							2	
SDT 96303 (Q1, Q2)	0.006				0.7	0.64	5.0					0.672	1.344
S≤10%	10		5.0		1.0							2	
JAN2N5038 (Q3-Q5)	0.006				0.7	0.88	5.0					0.1848	0.5544
S≤10%	2.0		5.0		1.0							3	
JAN2N3635 (Q6)	0.0091				0.7	0.64	1.0					0.04	0.04
S≤10%	2.0		5.0		1.0							1	
RCR07G____JS (R1, 2, 3, 4, 11)	0.0006						1.0					0.000036	0.00018
S≤30%	0.03		2.0									5	
RWR89S____FP (R5-R8, R10)	0.0038						1.0					0.00342	0.017
S≤10%	03		3.0									5	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 11.727 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A2 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION / COMPONENT / REMARKS	COMPUTATION FACTORS											PREDICTIONS	
	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
JANIN747A (CR1) S≤30%	0.0048				1.0							0.12	0.12
	5.0		5.0									1	
JANIN823A (CR12) S≤30%	0.0048				1.5							0.18	0.18
	5.0		5.0									1	
JANIN4938 (CR2-CR7)	0.0016				0.6	0.7	1.0					0.0168	0.10
S≤10%	5.0		5.0		1.0							6	
JANIN5415 (CR13, CR14)	0.0021				1.5	0.7	1.5					0.0826	0.1653
S≤20%	5.0		5.0		1.0							2	
JAN2N2222A (Q3)	0.006				0.7	0.64	1.0					0.02688	0.0537
JAN2N3500 (Q2) S≤10%	2.0		5.0		1.0							2	
JAN2N2907A (Q1) S≤10%	0.006				0.7	0.3	1.0					0.0126	0.0126
	2.0		5.0		1.0							1	
LM139J/883B			.55	0.0061								0.0613	0.0613
T=60°C	5.0	1.0	1.0	0.0089								1	
CR07G___JS	0.0004						1.0					0.000024	0.0004
S≤10%	0.03		2.0									17	
RNC55H____FR	0.0018						1.0					0.00045	0.008
S_{AVG} ≤20%	0.1		2.5									18	
RWR89S____FP	0.0038						1.0					0.00342	0.00684
S≤10%	03		3									2	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = .70094 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A2 Board/Ckt:

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
RT24C2P202 (R35)	0.012						1.0					0.18	
S<10%	5.0		3.0				1.0					1	0.18
M39014/01-----CKR05BX---KP (C5,6,7)	0.002											0.0012	
M39014/02-----(C9,10,11) S≤10%	0.3		2.0									6	0.0072
M39003/01 -----(C1-4,8,12)	0.013						[redacted]					0.0078	
S_{AVG} ≤ 50%	0.3		2.0					1.0				6	0.0468

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = .234 $\times 10^{-6}$ Failures/Hr

Equipment: EMIR 302 Assembly: A1-A3, A1'-A4 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
171C75HF432 (C1-C4)	0.1											0.6	2.4
1 $S \leq 80\%$	3		2									4	
426021-1 (L1, L2)	0.0022								8.0			0.0352	0.0704
			2.0									2	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 2.47 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A5 Board/Ckt:

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
JAN2N4948 (Q1)	0.016											0.64	
$S \leq 10\%$	8.0		5.0									1	0.64
JAN2N2222A (Q2,3,5-8,12,13) JAN2N3019 (Q14,15) JAN2N3421 (Q10,Q11) $S_{AVG} \leq 10\%$	0.006				0.7	0.36	1.0					0.0151	
	2.0		5.0		1.0							12	0.181
JAN2N2907A (Q4,9,16) $S \leq 10\%$	0.0091				0.7	0.36	1.0					0.0229	
	2.0		5.0		1.0							3	0.0688
JAN1N938B (CR1) JAN1N823 (CR2) $S \leq 30\%$	0.0048				1.5							0.18	
	5.0		5.0									2	0.36
JAN1N4938 (CR3) $S \leq 10\%$	0.0016				0.6	0.7	1.0					0.0168	
	5.0		5.0		1.0							1	0.0168
JAN1N5615 (CR5,6) $S \leq 10\%$	0.0016				1.5	0.7	1.0					0.042	
	5.0		5.0		1.0							2	0.084
RCR07G___JS $S_{AVG} \leq 10\%$	0.0004						1.0					0.000024	
	0.03		2.0									32	0.000768
RNC60H1783FR (R4) $S \leq 10\%$	0.0019						1.0					0.000475	
	0.1		2.5									1	0.000475
CKR05BX___KP (C3,4,6) CKR06BX___KP (C2,8,9) $S_{AVG} \leq 50\%$	0.011											0.0066	
	0.3		2.0									6	0.0396
CD4069BF/3 (Z1)			1.2	.0043								0.0628	
	5.0	1.0	1.0	.0074								1	0.0628

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 1.454 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A5 Board/Ckt: _____

Ambient Temperature = ___°C. Environment: _____ PAGE 11 OF 24

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
CD4027AF/3 (Z2)			1.2	.013								0.143	0.143
	5.0	1.0	1.0	.013								1	
CD4023AF/3 (Z3)			1.2	.0025								0.0435	0.0435
	5.0	1.0	1.0	.0057								1	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = .1865 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A6 Board/Ckt:

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	RATE
SDT 96303 (Q1-4, Q13-16)	0.006				0.7	0.64	5.0					0.672	8.064
SDT 96301 (Q9-Q12) S<10%	10.0		5.0		1.0							12	
JAN2N5038 (Q5-Q8)	0.006				0.7	0.64	5.0					0.1344	0.5376
S<10%	2.0		5.0		1.0							4	
JANIN3890 (CR1-CR10) JANIN3891 (CR11-CR14)	0.0016				1.5	0.7	4.0					0.336	3.36
JANIN1202A (CR1, CR2) S<10%	5.0		5.0		2.0							10	
JANIN5416 (CR3-CR6)	0.016				1.5	0.7	1.5					0.063	0.252
S<10%	5.0		5.0		1.0							4	
JANIN5615 (CR15, CR16)	0.0021				1.5	0.7	1.0					0.055	0.11
S<20%	5.0		5.0		1.0							2	
M83421/01-----P (C1, C2A, C2B)	0.002											0.0012	0.0036
S=50%	0.3		2.0									3	
EM39003/01-2546 (C3)	0.013											0.0078	0.0078
S<50%	0.3		2.0					1.0				1	
M39014/01-1495 (C4)	0.002											0.0012	0.0012
S<10%	0.3		2.0									1	
RWR89S----FP (R1-4, R10-17, 18) S<50%	0.01						1.0					0.009	0.189
RWR81S----FP (R6-9) R21, 22													
RWR84S----FP (R5A, R5B)	03		3									21	
RNC55H1741 FR (R19, 20)	0.0019						1.0					0.000475	0.00095
S<10%	0.1		2.5									2	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 12.526 x 10^{-6} Failure/Hr

Equipment: EMIR 302 Assembly: A1-A7 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION / COMPONENT / REMARKS	COMPUTATION FACTORS											PREDICTIONS	
	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{MPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
426013-1 (T1, T2)	0.0022								8.0			0.0352	0.0704
			2.0									2	
426012-1 (T3, T4)	0.0022								8.0			0.0352	0.0704
			2.0									2	
426010-1 (T5, T6)	0.0022								8.0			0.0352	0.0704
			2.0									2	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 3/2/79 PREDICTED FAILURE RATE = .2112 $\times 10^{-6}$ Failures/Hr

Equipment: EMIR 302 Assembly: A1-A8 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION / REMARKS	COMPUTATION FACTORS											PREDICTIONS	
	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
JAN2N3421 (Q1-Q12)	0.0071				0.7	1.65	1.0					0.082	0.984
S≤20%	2.0		5.0		1.0							12	
M39018/01-0735 (C1)	0.074											0.444	0.444
S≤70%	3.0		2.0									1	
M39014/01-1495 (C2-C7)	0.027											0.0162	0.097
S≤70%	0.3		2.0									6	
RCR07G___JS (R1-6, R7-18, R19-24)	0.0009						1.0					0.000054	0.0013
S≤50%	0.03		2.0									24	
RWR89S3011FP (R25-R30)	0.01						1.0					0.009	0.054
S≤50%	0.3		3									6	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 1.58 x10^{-6} Failures/Hr

Equipment: EMIR 302 Assembly: A1-A9 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
171C50JC1012 (C1)	0.1											0.6	
S<80%	3.0		2.0									1	0.6
722769-1 (C3)	0.0019											0.00114	
722769-2 (C2) S<80%	0.3		2.0									2	0.00228
M39014/02-1270 (C4)	0.002											0.0012	
S<10%	0.3		2.0									1	0.0012
~~JAN~~JAN1N645 (CR1-CR2)	0.0016				1.0	0.7						0.028	
S<10%	5.0		5.0		1.0							2	0.056
RCR07G512JS (R1)	0.0009						1.0					0.000054	
S<50%	0.03		2.0									1	0.000054
426020-1 (T1)	0.0022								8.0			0.0352	
			2.0									1	0.0352

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = .694 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A10 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TRPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
JANIN4938 (CR1-4)	0.0021				0.6	0.7	1.0					0.022	0.088
	5.0		5.0		1.0							4	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = .088 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A1-A11 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
M5757/23-001 (K1)			.0066						2.0			0.0117	0.0117
		1.48	2.0		3.0				0.1			1	
M55302/56-A40 (J1)	.019	7.42										0.5639	0.5639
			4.0									1	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = .5756 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A4 W Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
SNC5451B (Z23-40) SNC5400J (Z1,2,8)			0.55	0.0033								0.0410	1.068
SNC5486J (Z15-Z19)	5.0	1.0	1.0	0.0064								26	
SNC5404J (Z20-Z22)			0.55	0.0043								0.0483	0.145
	5.0	1.0	1.0	0.0073								3	
SNC5490J (Z4,6,7)			0.55	0.008								0.0745	0.2235
	5.0	1.0	1.0	0.0105								3	
SNC5492J (Z5,9,10)			0.55	0.012								0.098	0.294
	5.0	1.0	1.0	0.013								3	
SNC54124J (Z3)			0.55	0.0098								0.0819	0.0819
	5.0	1.0	1.0	0.011								1	
82523 (Z11,Z12,Z13)			0.62	0.032								0.1592	0.4776
	5.0	1.0	1.0	0.012								3	
LM139J/8838 (U1)			0.55	0.0061								0.0613	0.0613
	5.0	1.0	1.0	0.0089								1	
CRYSTAL (2.16MHz) X1												0.2	0.2
												1	
JANIN645 (CR7-9) S<10%	0.0016				0.6	0.7	1.0					0.0336	0.302
JANIN4938 (CR10-14,16)	5.0		5.0		2.0							9	
JANIN823 (CR15)	0.0048				1.5							0.18	0.18
	5.0		5.0									1	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 3.03 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A4 Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
RCR07G___JS	0.0004						1.0					0.000024	
$S_{ave} \leq 10\%$	0.03		2.0									81	0.00194
RNC55H____FR (R20,21,42)	0.0019						1.0					0.000475	
$S_{Ave} \leq 10\%$	0.1		2.5									3	0.00142
RWR81S60R4FP (R32)	0.0062						1.0					0.00558	
$S \leq 30\%$	0.3		3.0									1	0.00558
RT24C2P202 $S < 10\%$	0.012						1.0					0.18	
	5.0		3.0				1.0					1	0.18
M39014/01-____	0.002											0.0012	
M39014/02-____ $S_A \leq 10\%$	0.3		2.0									52	0.0624
M39003/01-____	0.019											0.0012	
$S_A \leq 60\%$	0.3		2.0					1.0				3	0.0036
JAN2N2222A (Q5,9,10)	0.006				0.7	0.3	1.0					0.0126	
JAN2N3019 (Q1-3) $S < 10\%$	2.0		5.0		1.0							6	0.0756
7J3334 (Q7)	0.006				0.7	0.3	2.5					0.1575	
$S < 10\%$	10.0		5.0		1.0							1	0.1575
JAN2N2907A (Q4,6,8,11)	0.0091				0.7	0.3	1.0					0.01911	
$S < 10\%$	2.0		5.0		1.0							4	0.07644
M55302/59-B90X (P2)	0.019	18										1.368	
M55302/57-B70X (P1)			4.0									2	2.736

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gould Date 2/2/79 PREDICTED FAILURE RATE = 3.3 X10^{-6} Failures/h

Equipment: EMIR 302 Assembly: AS, ASAY Board/Ckt: _____

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
JANIN3890 (CR1)	0.0016				1.5	0.7	4.0					0.67	
S<10%	5.0		5.0		2.0							1	0.67
JAN2N5038 (Q1,4,5,6)	0.006				0.7	1.2	5.0					0.252	
S<10%	2.0		5.0		1.0							4	1.008
713334 (Q2,Q3)	0.006				0.7	1.2	2.5					0.63	
S<10%	10.0		5.0		1.0							2	1.26
426015-1 (T1)	0.0022								8.0			0.0352	
			2.0									1	0.0352
M55302/56-A40 (J1)	0.019	14.6										1.1	
			4.0									1	1.1
275007	0.1											0.1	
												1	0.1
RCR07G___JS	0.00055						1.0					0.000033	
RCR20G___JS S≤25%	0.03		2.0									27	0.00089
RWR81S___FP	0.0055						1.0					0.00495	
RWR89S___FP S≤25%	0.3		3									5	0.02475
RNC55H___FR S≤15%	0.0017						1.0					0.000425	
	0.1		2.5									11	0.004675
RT24C2P202 (R18) S<10%	0.012						1.0					0.18	
55-1-8-102P (R45)	5.0		3.0				1.0					2	0.36

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/77 PREDICTED FAILURE RATE = 4.563 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A5A1 Board/Ckt:

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
M39018/01-0738 (C1) S<60%	0.054											0.324	
M39018/01-0749 (C3A,B,C)	3		2									4	1.296
M39014/01-1268 (C4) S<10%	0.062											0.0012	
M39014/02-0270 (C5,6,8-10) M39014/02-0262 (C11)	0.3		2.0									7	0.0084
M39003/01-2503 (C2) S<60%	0.019											0.0114	
M39003/01-2535 (C7)	0.3		2.0					1.0				2	0.0228
LM139J/883B (U1)			0.55	0.0061								0.0612	
	5.0	1.0	1.0	0.8089								1	0.0612
JANIN4938 (CR2,3,7,9-12)	0.0016				0.6	0.7	1.0	[redacted]				0.01683	
S<10%	5.0		5.0		1.0							7	0.1176
JANIN5615 (CR1,13,16)	0.0016				1.5	0.7	1.0					0.042	
S<10%	5.0		5.0		1.0							3	0.126
JANIN5416 (CR14,15)	0.0027				1.5	0.7	1.5					0.106	
S<30%	5.0		5.0		1.0							2	0.212
JANIN747A (CR4)	0.0048				1.0							0.12	
	5.0		5.0		[redacted]							1	0.12
JANIN823 (CR5,6,8)	0.0048				1.5							0.18	
JANIN938B (CR17)	5.0		5.0									[redacted]4	0.72
JAN2N2907A (Q3,4)	0.0091				0.7	0.3	1.0					0.019	
JAN2N3635 (Q1) S<10%	2.0		5.0		1.0							3	0.0573

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 9/12/79 PREDICTED FAILURE RATE = 2.741 $\times 10^{-6}$ Failures/H

Equipment: EMIR 302 Assembly: A5A1 Board/Ckt:

Ambient Temperature = 50 °C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
JAN2N3421 (Q2,Q5)	0.0071				0.7	1.2	1.0					0.059	
S<20%	2.0		5.0		1.0							2	0.119
326023-1 (L1)	0.0022								8.0			0.0352	
			2.0									1	0.0352
326024-1 (L2)	0.0022								8.0			0.0352	
			2.0									1	0.0352

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = .1894 X10^{-6} Failures/H

Equipment: EMIR 302 Assembly: ASA2 "1" Board/Ckt: _____

Ambient Temperature = 50°C. Environment: GROUND FIXED

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	RATE
M39003/01-2503 (C1) S<60%	0.019											0.0114	0.0684
M39003/01-2535 (C2-6)	0.3		2.0					1.0				6	
JANIN5416 (CR1-4)	0.0027				1.5	0.7	1.5					0.106	0.425
S<30%	5.0		5.0		1.0							4	
JANIN5615 (CR5-14)	0.0016				1.5	0.7	1.0					0.042	0.42
S<10%	5.0		5.0		1.0							10	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 0.9134 $\times 10^{-6}$ Failures/Hr

Equipment: EMIR 302 Assembly: A6 Board/Ckt:

Ambient Temperature = 50 °C. Environment: GROUND FIXED PAGE 24 OF 24

PART IDENTIFICATION	COMPUTATION FACTORS											PREDICTIONS	
COMPONENT / REMARKS	λ_b	π_P	π_T	C_1	π_A	π_{S2}	π_R	π_{CV}	π_F			λ_p	FAILURE RATE
	π_Q	π_L	π_E	C_2	π_C	π_{TAPS}	π_V	π_{SR}	π_{CYC}			QUANTITY	
326092-1 (L1-4)	0.0022								8.0			0.0352	0.1408
			2.0									4	
E12D105KXC (C1-4)	0.0019											0.00114	0.00456
S<80%	0.3		2.0									4	

All Failure Rates are listed in FAILURES PER 10^6 HOURS

Prepared by S. Gandhi Date 2/2/79 PREDICTED FAILURE RATE = 0.1454 $\times 10^{-6}$ Failures/H